2012 Long-Term Monitoring Annual Report

Metal Bank Cottman Avenue
Superfund Site
Philadelphia, PA

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Acronyms and Abbreviations

DRBC	Delaware River Basin Commission
E&S	erosion and sediment
ft	feet
GLNPO	Great Lakes National Program Office
IQR	interquartile range
LNAPL	light non-aqueous phase liquid
LOEC	lowest observed effect concentration
LTM WP	long-term monitoring work plan
LTM	long-term monitoring
mg/kg	milligram(s) per kilogram
msl	above mean sea level
NOEC	no observed effect concentration
NPL	National Priorities List
PCB	polychlorinated biphenyl
ppm	part per million
PRP	potentially responsible party
QAPP	quality assurance project plan
SOP	standard operating procedure
SVOC	semivolatile organic compound
USEPA	United States Environmental Protection Agency
UST	underground storage tank

1 Introduction

This annual report is a component of the long-term monitoring (LTM) requirements associated with the Metal Bank Cottman Avenue Superfund Site (the Site, Figure 1). This report summarizes the monitoring activities conducted at the Site on behalf of the Cottman Avenue Utility potentially responsible party (PRP) group (the Group) from January 1, 2012, through December 31, 2012. Activities conducted after December 31, 2012, will be summarized in the next annual report (early 2014).

1.1 Site Background

The Site was used for the storage and reclamation of various scrap metals from 1962 until 1979, with scrap metal storage possibly continuing until 1984 or 1985.[1] The oil from electrical transformer salvage operations at the Site was reportedly discharged to a concrete catch basin connected to an underground storage tank (UST). In 1972 the UST ruptured and transformer oil containing polychlorinated biphenyls (PCBs) was released to the Delaware River.[2] The Site was added to the National Priorities List (NPL) in September 1983, and the United States Environmental Protection Agency (USEPA) issued the formal Record of Decision specifying the selected remedial approach in December 1997. Following the adoption of three consent decrees in March 2006, a revised final design specifying the details of the cleanup activities was approved (with comments) in February 2008. Construction activities took place between July 2008 and March 2010, and included the following:[3]

- Excavation of courtyard area soils and placement of a soil cap over the courtyard area and foundations of former Buildings 2, 3, 4, 5, and 6
- Power washing and sealing of the courtyard Building 7 floor slab and the railroad spur within Building 7
- Installation of a sheetpile wall at the southwestern corner of the Site
- Installation of a light nonaqueous phase liquid (LNAPL) interceptor trench at the southwestern corner of the Site
- Installation of erosion and sediment (E&S) control measures around the Site perimeter
- Removal of the UST near the southwest corner of the Site and removal and closure of other USTs encountered during construction of the remedy
- Excavation and off-site disposal of soil from southern area hot spots SA-2, SA-3, and SA-4/5
- Installation of a soil cap over the southern area
- Planting of vegetation to provide erosion protection, habitat, and aesthetic improvement

[1] Pre-Design Investigation Report, Metal Bank NPL Site, Philadelphia, PA. January 21, 2000. Ogden Environmental and Energy Services Co., Inc. and Hart Crowser, Inc.

[2] USEPA Metal Bank Superfund Page (http://www.epa.gov/reg3hwmd/npl/PAD046557096.htm)

[3] Metal Bank NPL Site Remediation Project – Engineer's Report. Draft May 2010. Malcolm Pirnie, Inc.

- Excavation of nearshore sediments and capping of other sediment areas previously shown to have total PCB concentrations of greater than 1 part per million (ppm)

The construction phase was officially completed when the preliminary close-out report was approved in March 2010. To ensure long-term protectiveness of the selected remedy, LTM and maintenance activities are required. These requirements are outlined in the May 2010 long-term monitoring work plan (LTM WP; ARCADIS 2010), revised in April 2011 (ARCADIS 2011a). This annual report summarizes the monitoring and maintenance activities performed at the Site from January 1, 2012, through December 31, 2012. The following sections describe the various monitoring components implemented during the post-construction period and the LTM period as specified in the LTM WP.

1.2 Long-Term Monitoring Program

The LTM at the Site was initiated on July 1, 2010, and includes the following components and tasks:

	Task	Reference
1	**Groundwater Monitoring**	LTM WP § 4.3
2	**LNAPL Trench Monitoring**	LTM WP § 4.4
3	**Upland Monitoring**	LTM WP § 4.2
	E&S Control Measures	LTM WP § 4.2
	Soil Cap and Vegetation	LTM WP § 4.2
	Building 7	LTM WP § 4.2
	Sheetpile	LTM WP § 4.8
4	**Mudflat Backfill and Marine Mattress Inspections**	
	Mudflat Backfill	LTM WP § 4.6
	Marine Mattresses	LTM WP § 4.6
	Sediment Accumulation	LTM WP § 4.7
5	**Biological Monitoring**	
	Fish Tissue Study	LTM WP § 4.9
	Bioaccumulation Study	LTM WP § 4.5
	Benthic Community Survey	LTM WP § 4.5

Notes: LTM WP = LTM Work Plan, May 2010, Revised April 2011

The following sections describe the work performed by the Group to meet the LTM requirements specified in the LTM WP (ARCADIS 2010, ARCADIS 2011a), the fish study addendum (ARCADIS 2011b), the vegetative cover plan (ARCADIS July 2011c, ENVIRON 2011a, ENVIRON 2012a), the invasive species control plan (ENVIRON 2012b), and the February 9, 2012, USEPA (2012) letter regarding survey requirements at the Site.

2 Groundwater Monitoring

2.1 Objective

The objective of the groundwater monitoring task is to evaluate whether contaminants may be present and migrating from groundwater to surface water. In the longer term (5+ years), the data will also be used to evaluate whether downward concentration trends can be observed.

2.2 Approach

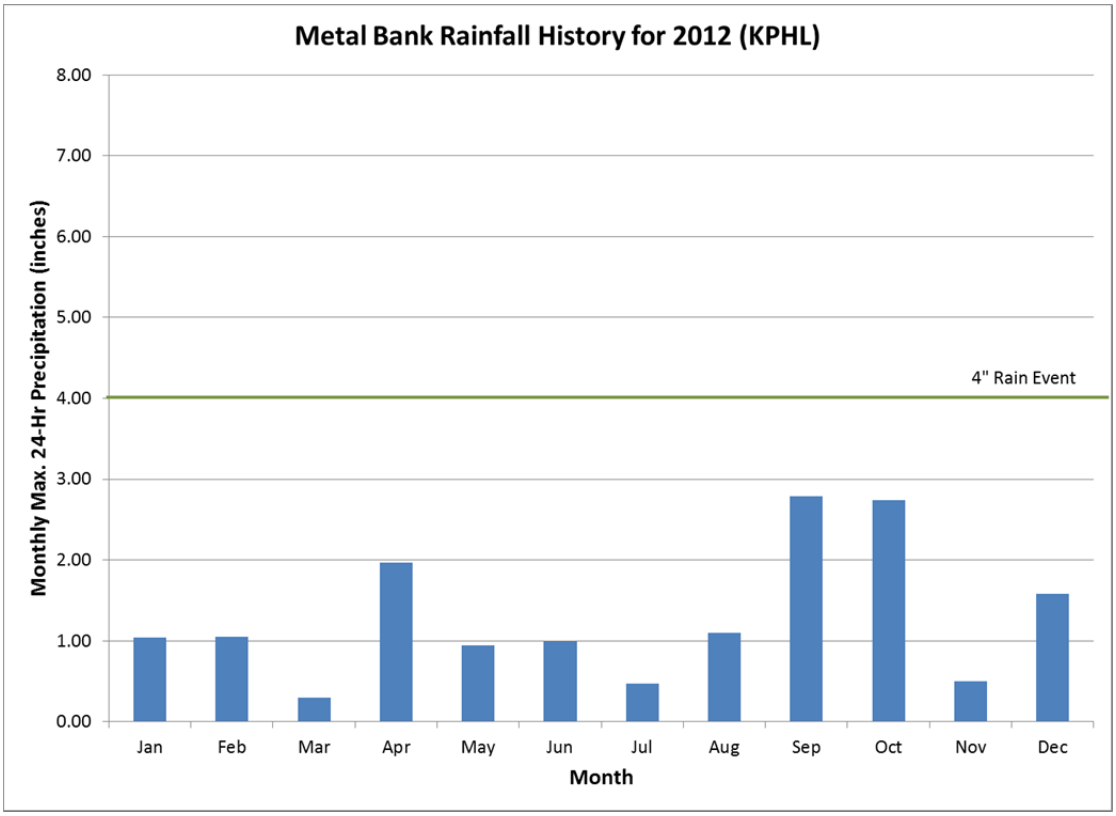
Table 2-1 summarizes the approach for the groundwater monitoring component of the LTM program. Additional details on the specific procedures and monitoring requirements can be found in the LTM WP (ARCADIS 2010, 2011) and the LTM final field sampling plan (ARCADIS 2010, ARCADIS 2011b). Analytical parameters included in the monitoring program are PCB Aroclors and semivolatile organic compounds (SVOCs). In previous years, PCB congeners and dioxins were also monitored. Groundwater monitoring well locations are depicted on Figure 2.

2.3 Activities

The 2012 groundwater sampling and elevation monitoring was performed on a semiannual schedule in the second (April 24-25) and fourth (October 17-18) quarters of the year, as specified in the LTM WP. A total of eight long-term groundwater monitoring events have now been completed since LTM began in July 2010 (see Table 2-2).

Supplemental groundwater elevation measurements triggered by precipitation or flood events were not conducted in 2012. The precipitation-based action level was not triggered in 2012, as no precipitation events produced more than 4 inches of rainfall in a 24-hour period (see Illustration 2-1). However, it is likely that Hurricane Sandy triggered the flood-based action level of a 100-year flood, though we lack Site-specific stream gauge data to confirm this. Nevertheless, based on the observed historical range of quarterly groundwater fluctuations (<2 ft within any given well) and a post-Sandy Site inspection, which noted the absence of water marks in the trench vaults, trench water levels of approximately 8-10 ft below grade, and no observable LNAPL in the trench, there is no evidence of recontamination of the soil cap through rising water levels attributable to Sandy.

Illustration 2-1. Monthly Maximum 24-hour Precipitation Data for Philadelphia International Airport (Data Source: Pennsylvania State Climatologist)



2.4 Results

In 2012, the groundwater at the Site was sampled for PCB Aroclors and SVOCs[4]. These compounds, when present, were found at trace level concentrations, similar to previous years. Table 2-3 summarizes the groundwater monitoring results obtained to date.

Laboratory reports containing groundwater sampling analytical data are included in Appendix A. Data validation reports, including a time series table of historical groundwater monitoring results on a well-by-well basis are provided in Appendix B.

Measured groundwater elevations at the Site in 2012 ranged from 6.90 ft above mean sea level (msl) (at MW-2) to 0.12 ft msl (at MW-5), which is within the range of groundwater elevations recorded in previous years (8.50 to–0.57 ft msl). Groundwater fluctuations at each of the wells over eight rounds of measurements since 2010 range from 1.70 ft (at MW-5) to 1.23 ft (at MW-

[4] PCB congeners and dioxins were removed from the sampling program at the end of 2011 (August 25, 2011 Letter from ARCADIS to USEPA RE: Groundwater Sampling Program and October 5, 2011, USEPA Response Letter).

6). A table summarizing groundwater elevations at the six on-site monitoring wells is provided in Appendix C.

2.5 Conclusions

There are no significant concentrations of contaminants of concern in Site groundwater. While there are no actionable groundwater thresholds for the Site, the contaminants that have been detected, such as PCBs and dioxins, have been found at levels well below USEPA drinking water standards. Based on the data collected to date, the objectives of the groundwater monitoring are being met, and contaminant migration via groundwater appears to be negligible.

3 Monitoring of the LNAPL Trench

3.1 Objective

The objective of the LNAPL trench monitoring task is to evaluate whether LNAPL is present and whether contaminants may be migrating from groundwater to surface water.

3.2 Approach

Table 3-1 summarizes the approach for the LNAPL trench monitoring component of the LTM program. Additional details on the specific procedures and monitoring requirements can be found in the LTM WP (ARCADIS 2010, 2011a) and the LTM final field sampling plan (ARCADIS 2010b, 2011b). Figure 2 shows the location of the LNAPL trench and trench sumps.

3.3 Activities

LNAPL trench monitoring was performed quarterly in 2012, as required by the LTM. A total of 17 monitoring events have now taken place since the post-construction period (see Table 3-2). As described in Section 2.3 and Illustration 2-1, there were no storm events with greater than 4-inch rainfall in a 24-hour period in 2012; however, it is likely that Hurricane Sandy triggered the flood-based requirement for additional elevation monitoring of the water in the LNAPL trench. Though a 0.01-ft accurate elevation measurement was not obtained during the post-Sandy Site inspection, water depths in the trench were observed to be approximately 8 to10 ft below ground surface (see photo log in Appendix E). Based on these observations we see no evidence that soil cap recontamination occurred.

3.4 Results

No measurable free product has been observed at the LNAPL trench during any of the 17 inspections conducted to date. Measured trench groundwater elevations at the Site have ranged between approximately 0 and 2 ft msl since monitoring began. More accurate elevation measurements will be available once we survey the top of the corrugated plastic pipes in the trench vaults[5]. Groundwater fluctuations at each of the LNAPL trench sumps over 17 rounds of measurements have ranged from 2.23 ft (at Sump 2) to 1.36 ft (at Sump 1). A table summarizing LNAPL thickness and approximate groundwater elevations at the five trench sumps is provided in Appendix D.

3.5 Conclusions

The objectives of the LNAPL trench monitoring are being met. No observable amounts of LNAPL potentially containing PCBs are present in the groundwater at the Site. PCBs have relatively high solubility in oils and very low solubility in water. Therefore, the only significant transport mechanism for PCBs in the subsurface environment is the migration of LNAPL. Since the completion of the construction of the final remedy, no measurable product has been

[5] Previously reported LNAPL trench groundwater elevations contained a mathematical error, skewing reported elevations high by approximately 4 ft. Specifically, groundwater depths were measured from the top of the corrugated pipe, but the elevations of the top of the concrete vaults were used to convert these depth measurements to groundwater elevations. The distance between the pipe and the concrete is approximately 4 ft. We used this estimate to calculate the groundwater elevations in the LNAPL trench sumps (reported in Appendix D). As a result, the trench groundwater elevation data in this report should be viewed as approximate (within 1 ft accuracy) until the top of the corrugated plastic pipes can be surveyed.

observed in the trench, which strongly suggests that no significant amounts of PCBs are migrating off the Metal Bank property into the tidal mudflats and the Delaware River. Furthermore, it has been our experience that the maximum free product levels to be observed occur within three to six months of construction when soils are disturbed and oils trapped within the interstitial spaces of the soil particles are released. We have measured no observable amounts of LNAPL since the completion of construction over three years ago, and we strongly expect this trend to continue in the foreseeable future.

4 Upland Inspections

4.1 Objective

The objective of the upland inspections is to monitor features that prevent direct exposure to Site contaminants and to prevent off-site migration of contaminants via surface run-off.

4.2 Approach

The general approach to the upland inspections is to inspect and maintain measures put in place during the remedy construction phase to prevent direct exposure to Site contaminants and to prevent off-site migration of contaminants via surface run-off. These measures include the following:

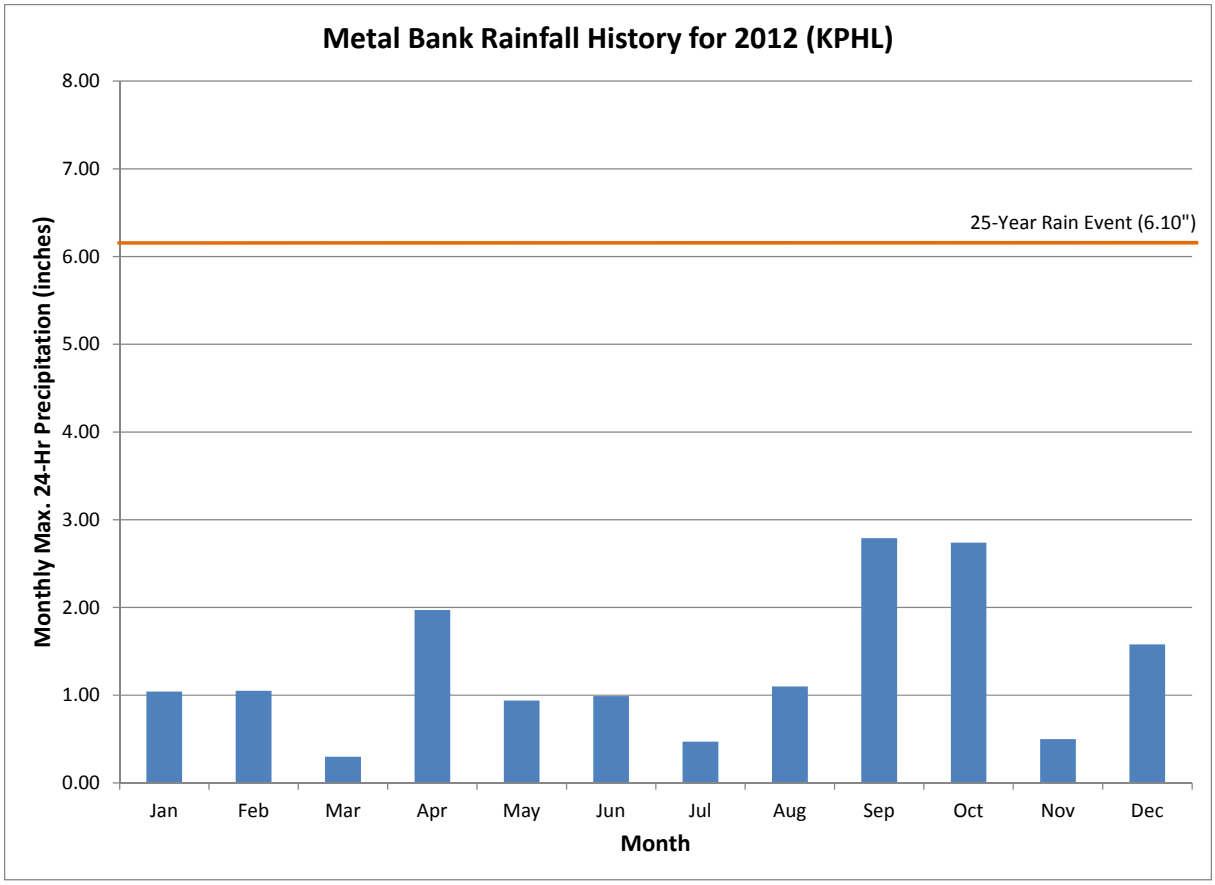
- E&S control measures around the perimeter of the Site
- Two vegetated soil cap areas (courtyard area and southern area)
- The sealed floor slab at Building 7
- The sheetpile wall at the southwestern corner of the Site

Table 4-1 summarizes the approach for the upland inspection component of the LTM program. Additional details on the specific procedures and inspection requirements can be found in the LTM WP (ARCADIS 2010a, 2011a), the LTM final field sampling plan (ARCADIS 2010b, 2011b), the vegetative cover plan (ARCADIS 2011c, ENVIRON 2011a, ENVIRON 2012a), the invasive species control plan (ENVIRON 2012b), and USEPA correspondence dated March 22, 2011, and July 11, 2011(USEPA 2011a, 2011b). The features relevant to this section are depicted on Figure 2.

4.3 Activities

Table 4-2 summarizes the activities performed as part of the post-construction upland monitoring (post final inspection). Inspection and monitoring occurred on a scheduled basis, according to the LTM requirements and the approach described in Table 4-1. Maintenance and repair activities were performed on an as needed basis. As demonstrated in Illustration 4-1, there were no rain events in 2012 that would trigger additional upland inspection requirements (25-year rain event).

Illustration 4-1. Monthly Maximum 24-hour Precipitation Data for Philadelphia International Airport (Data Source: Pennsylvania State Climatologist)



4.4 Results

Results of the upland monitoring, broken down by task, are summarized below:

A. Erosion and Sediment Control

E&S control measures were monitored on a quarterly schedule, as required by the LTM WP. Most quarterly inspections identified some E&S control measures in need of maintenance, replacement, and/or repair. These issues were reported to USEPA and maintained, replaced, and/or repaired, as needed. While some minor erosion has been observed within Site boundaries, there is no evidence that sediments have migrated beyond the Site perimeter E&S control measures. Site inspection reports are provided in Appendix E.

B. Vegetative Cap

1. Cap Integrity

Cap integrity has been visually assessed on a quarterly schedule, as required by the LTM WP. No signs of settlement, cracks, fissures, seeps, or direct signs of erosion were observed on the upland cap areas, with the exception of some minor ruts, which were restored by hand-grading.

2. Vegetation Monitoring and Mowing

Vegetation monitoring was performed in May 2012. In addition, qualitative assessments of vegetative cover have been performed as part of the quarterly and post-Sandy Site inspections and 5-year review inspection. Vegetative cover at the Site meets the LTM requirements of >80% site-wide coverage. Minor areas of sparse vegetation were reseeded in October 2012 to further improve vegetative cover. Invasive species currently occupy less than 10% of the Site. Herbicide applications to control invasive species are scheduled for spring 2013, following the approach outlined in the July 2012 Invasive Species Control Plan (ENVIRON 2012b). Site-wide mowing was performed in October. Small areas between the fence and property line were mowed in November 2012 following the 5-year review inspection.

The vegetation at the Site appears to be effectively controlling erosion of the soil caps, preventing off-site contaminant transport. No sediments have been observed at the bottom of Site outfalls near the Delaware River, and Hurricane Sandy did not cause any notable damage or erosion at the Site.

Detailed quantitative information related to the vegetative cover and invasive species is provided in Appendix F. Qualitative assessments of vegetative cover are provided in the Site inspection reports included in Appendix E.

3. Cap Surveys

In addition to performing an upland cap survey using standard surveying methods, direct measurements of cap thickness were obtained through a series of test pits installed at 24 locations throughout the capped area, selected by an on-site USEPA contractor (CDM). The upland cap survey yielded similar results to the two previous surveys performed in 2009 and 2010 indicating that erosion to date remains minimal. This is supported by the results of the soil cap thickness assessment, which indicate that soil cap thickness continues to meet or exceed minimum design criteria. Given the well-vegetated condition of the soil cap, we expect the potential for erosion to remain low. Based on these survey results, the frequency of future surveys will be reduced to every five years, as approved by USEPA in correspondence dated February 9, 2012. Complete survey results are provided in Appendix G.

C. Building 7

The Building 7 epoxy-coated floor slab has been monitored as part of the quarterly Site inspections, which exceeds the LTM WP requirement of one floor inspection per year. No exposed patches of floor slab greater than 10 square centimeters have been observed, and no repairs have been necessary during 2012.

D. Sheetpile

The tilt, rotation, deflection, and condition of the southwest sheetpile wall were monitored on a quarterly basis for the first three quarters of 2012, in accordance with the LTM WP. The sheetpile wall was observed to be in good condition, and the tilt is well below the 2-degree action level with recorded values ranging from (-0.050 to 0.071 degrees). The two years of monitoring required by the LTM WP were completed in July 2012. Based on the results, no further tilt monitoring is required. However, as a result of the 5-year review Inspection, USEPA and the Group agreed that the current sheetpile wall inspection protocols are not sufficient to fully assess the structural stability of the sheetpile. Changes to the sheetpile wall inspection protocols will be addressed under separate cover.

4.5 Conclusions

Based on current inspections and observations, the Site is well vegetated, and vegetation levels on the upland caps meet LTM WP requirements for both degree of coverage (>80%) and invasive species (<10%). As a result, potential for erosion at the Site is very low. This is supported by direct visual observations and survey results, which found erosion at the Site to be negligible. Specifically, no sediments have been observed beyond the Site perimeter E&S control measures, and the cap remains 2- to 4-feet (ft) thick and in good condition, as designed and constructed. Based on the above, we conclude that the overall objectives of the upland remedy components are being met.

5 Mudflat Backfill and Marine Mattress Inspections

5.1 Objective

The objective of the mudflat backfill, marine mattress, and sediment accumulation inspections is to verify that the remedy prevents off-site migration of contaminants via surface water.

5.2 Approach

The general approach of this task is to inspect and maintain (if necessary) measures put in place during the remedy construction phase to prevent off-site migration of contaminated sediments via surface water. This task can be broken down into the following components:

- Mudflat backfill survey and integrity verification
- Marine mattress bathymetric survey and integrity verification
- Sediment accumulation survey

Table 5-1 summarizes the approach for the mudflat backfill, marine mattress, and sediment accumulation inspection component of the LTM program. Additional details on the specific procedures and inspection requirements can be found in the LTM WP (ARCADIS 2010a, 2011a); the LTM final field sampling plan (ARCADIS 2010b, 2011b); USEPA correspondence dated April 27, (USEPA 2011c); ENVIRON correspondence dated October 26, 2011 (ENVIRON 2011b); USEPA correspondence dated February 9, 2012 (USEPA 2012); and ENVIRON correspondence dated March 9, 2012 (ENVIRON 2012d). The features relevant to this section are depicted on Figure 2.

5.3 Activities

Mudflat backfill, marine mattress, and sediment accumulation inspections, including a bathymetric survey, were conducted in June 2012, and an additional visual inspection of the mudflat backfill and marine mattresses was performed in November 2012 (Table 5-2). There were no 25-year storms in 2012 that triggered additional inspection requirements, and no tidal current velocity data from Trenton, New Jersey, was available (see Section 5.4). In addition, at USEPA's request, danger buoys were deployed around the subaqueous caps in June 2012.

5.4 Results

The results of the mudflat backfill, marine mattress, and sediment accumulation inspections and surveys are summarized below:

- The 2012 visual mudflat backfill and marine mattress inspection showed no signs of damage or proximal erosion.
- The 2012 visual mudflat backfill and marine mattress survey indicated no material change in position compared to the previous surveys (within 0.5 ft to 1 ft tolerances, see Appendix G).
- The 2012 sediment accumulation inspection showed 0-12 inches of accumulation on the subaqueous caps (see Appendix G).

Based on the results of the mudflat backfill, marine mattress, and sediment accumulation inspections and surveys, the bathymetric survey frequency will be reduced to every five years and following tidal current events in excess of 125 centimeters per second as measured at the US Coast Guard Station in Trenton, New Jersey, as specified in USEPA correspondence dated February 9, 2012 (USEPA 2012). Though we were not able to obtain data on tidal current velocities in Trenton, peak stream discharge values in 2012 were well below values recorded in 2011 (Illustration 5-1).

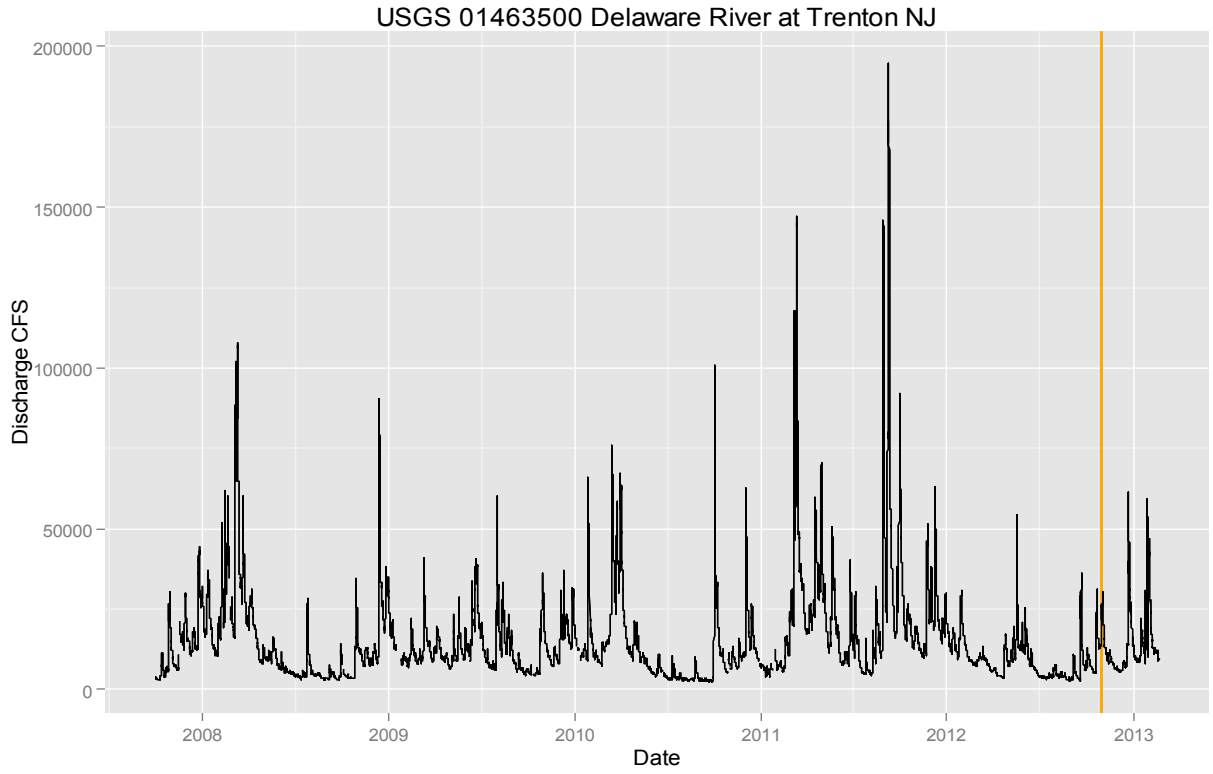


Illustration 5-1. Daily Discharge Volume in the Delaware River (Trenton) from 2008 to 2012

Because the bathymetric survey performed in June 2012 found no material change from as-built conditions, we believe that tidal flow velocities in 2012 had no negative impact on the integrity of the subaqueous caps.

5.5 Conclusions

The objectives of the mudflat backfill, marine mattress, and sediment accumulation inspections and surveys are being met. The backfill and subaqueous caps appear to be stable and in good condition. No contaminated sediment transport has been observed in the aquatic environment.

6 Biological Monitoring

6.1 Objective

The objective of the biological monitoring program is to evaluate PCBs in fish, PCB bioaccumulation in benthos, and benthic community structure in the aquatic environment adjacent to the Site and in nearby reference areas.

6.2 Approach

Biological monitoring consists of three separate tasks: 1) a fish monitoring study, 2) in situ caged sediment bioaccumulation monitoring, and 3) the collection of sediment infauna samples for community structure monitoring. Table 6-1 summarizes the approach for the three tasks. Additional details on the specific procedures and requirements can be found in the LTM WP (ARCADIS 2010a, 2011a), the LTM final field sampling plan (ARCADIS 2010b, 2011b), the addendum to the fish tissue study (ARCADIS 2011b) the revised fish quality assurance project plan (QAPP) addendum (Environmental Standards 2012a), addendum to the Lumbriculus Study QAPP (Environmental Standards 2012b), and revised Lumbriculus standard operating procedure (SOP) (ENVIRON 2012e).

6.3 Activities

The biological monitoring program activities conducted in 2012 are shown in Table 6-2 and included (1) a fish study designed to measure total PCBs in whole body forage fish and compare concentration proximate to the Site to reference areas, (2) in situ bioaccumulation monitoring designed to quantify the sediment biota bioaccumulation factor, and (3) a benthic community structure investigation to characterize the health of the benthic community on the mudflat and compare it to reference areas. Based on the requirements outlined in the LTM, all required biological monitoring activities have now been completed.

6.4 Results

The following presents the results of the fish study, the bioaccumulation study, and the benthic community survey.

6.4.1 Fish Study

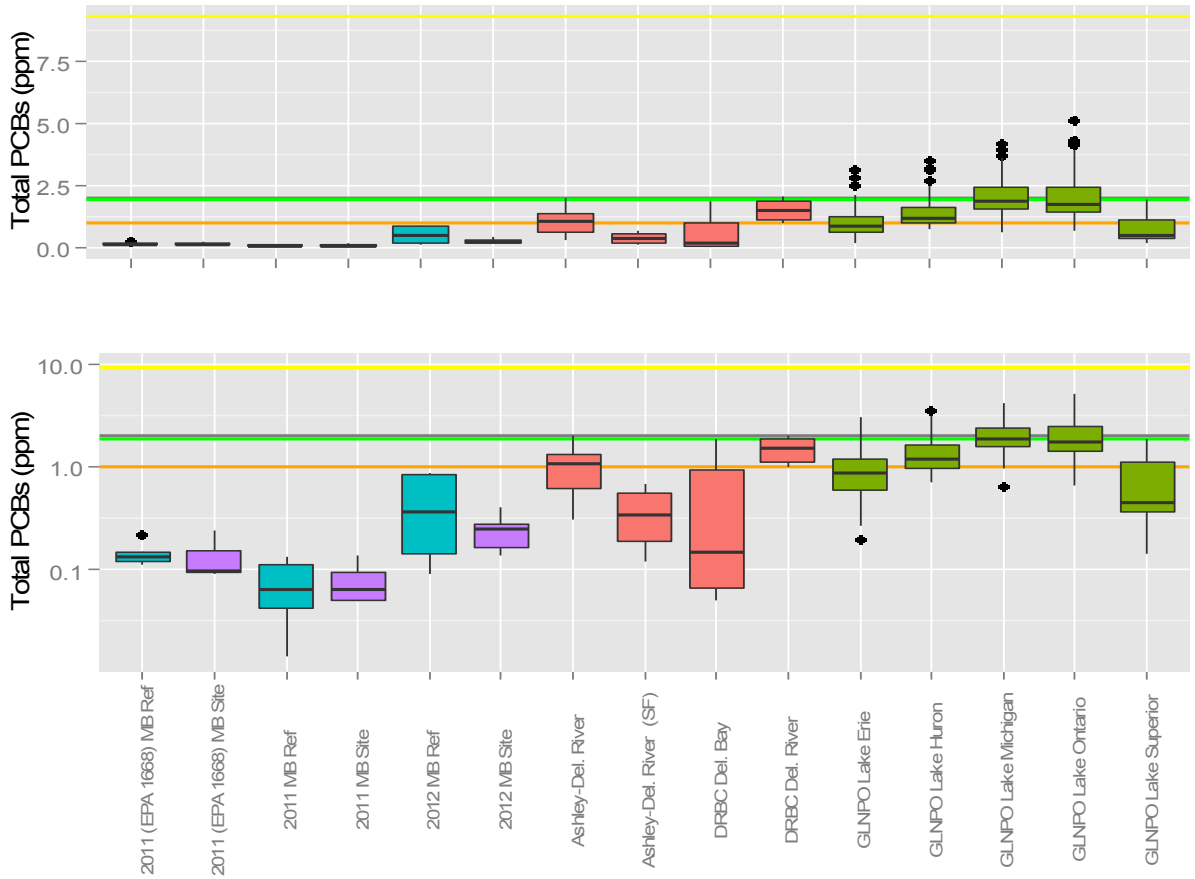
The results of the Group's analyses in 2011 and 2012 (Appendix I) and the split analyses conducted by USEPA in 2011 were compared. The analytical results from the USEPA splits of the 2012 samples have not yet been validated by the Group and will be discussed in a subsequent document. In 2011 there was significant discrepancy between the Aroclor-based results reported by USEPA and USEPA's congener-based results and the Group's Aroclor-based results (ENVIRON 2012c). Therefore, USEPA's 2011 Aroclor-based results are not included in this analysis. Total PCBs from the 2011 and 2012 fish monitoring are reported in Table 6-3. All of the values are below the 1ppm value that triggers additional analysis and consideration of the fish tissue.

A number of effects-based tissue concentrations for forage fish, such as those targeted by the sampling program, are available from the literature. Table 6-4 summarizes the literature values by PCB mixture and endpoint. The lowest concentration was reported in Matta et al. (2001) who reported an increase in body weight at 1.5 milligrams per kilogram (mg/kg) body burden. The

lowest negative effects concentrations were observed in Hansen et al. (1974) with a reported no observed effect concentration (NOEC) of 1.9 ppm and a lowest observed effect concentration (LOEC) of 9.3 ppm.

We updated the comparison of the PCB results of the Metal Bank fish study to other fish studies that present PCB results for the Delaware River and the Great Lakes. We used the USEPA Method1668 congener results from 2011 and the Group's Aroclor-based results from 2011 and 2012 for these comparisons. All of the fish samples used in these comparisons were whole body and were reported on a wet weight basis. Data was obtained from the Delaware River Basin Commission (DRBC) 2000 fish samples (DRBC 2000), the 2001 and 2002 DRBC fish samples (Ashley et al. 2004), and the Great Lakes National Program Office (GLNPO) (USEPA 2003). The Ashley data was divided into two classes—large and small fish—with small fish denoted as SF (Illustration 6-1). The data associated with each data set are presented using standard box plots (Tukey 1977).

Illustration 6-1. Total PCBs in Fish Tissue



In the standard box plots, the median (50th percentile) of each data set is shown with a horizontal line. The boxes denote the interquartile range (IQR), which is the range between the 25th and the 75th percentiles. The whiskers denote the most extreme samples less than 1.5 x the IQR outside of the boxes. Filled circles denote sample results outside of the whiskers.

Illustration 6-1 presents total PCB values on both a standard scale and a log base 10 scale. The green line denotes the NOEC from Hansen et al. 1974; the yellow line denotes the LOEC from Hansen et al. 1974; the gray line denotes the Food and Drug Administration action level of 2 ppm; and the orange line is the 1 ppm threshold applicable at the Metal Bank Site. Although we included the 1668 data for these comparisons, this should not be construed as an endorsement of the 1668 data over the 8082 data.

The results show considerable overlap between the Metal Bank data and previous observations from the Delaware River and the Great Lakes. In fact, the results from the Metal Bank Site are among the lowest in this data compilation. The results of the fish monitoring program show that the LTM program fish tissue concentrations are comfortably below the threshold value of 1 ppm. When the values are compared to fish tissue results from other investigations of the Delaware River and the Great Lakes, it is apparent that the values from the fish monitoring program are well below applicable background values and indicate that there is no localized elevation of the PCB concentration in fish tissue in the vicinity of the Site.

In addition to comparisons to background we compared the Site and reference area results for 2011 and 2012. A t-test indicated no statistically significant difference between the Site and reference area samples for the 2012 Aroclor-based results ($p = 0.33$). We also compared the 2011 Site data to the 2012 Site data using a t-test. For the Aroclor-based results the 2011 data (mean = 0.08) was statistically different from the 2012 (mean = 0.26) at a significance level of 0.02. When the 2011 congener-based data was compared to the 2012 Aroclor-based data there was no statistically significant difference ($p = 0.19$). Based on the inconsistent results when comparing the 2011 and 2012 data, it is inappropriate to conclude that there is a significant difference between the 2011 and 2012 on-site data that is not attributable to analytical uncertainty. In fact, following a review of the 2011 data, significant changes in the analysis procedures were implemented, including refined sample handling procedures and the addition of standard reference material to monitor laboratory performance. The results show that there was no significant difference between the on-site fish samples and the reference area fish samples in 2012 and therefore no increase in fish tissue concentrations near the Site. In fact, the mean on-site concentration (0.24) was lower than the mean reference area concentration (0.49). The results do not provide strong evidence for an increasing or decreasing trend between 2011 and 2012. The low values of the PCB concentrations and lack of clear trends are consistent with PCB concentrations at background levels, indicating that the Site is not a significant contributor to the PCB levels in fish tissues. In addition, sediment data collected as part of the bioaccumulation study (Section 6.4.2) are below the 1 ppm benchmark. Based on this fact and the fact that PCBs in fish tissues are present at background levels, we conclude that the sediment benchmark of 1ppm is sufficiently protective of the aquatic environment.

6.4.2 Bioaccumulation Study

The most recent round of bioaccumulation testing was completed in June and July of 2012. As documented in Appendix J, the test chambers were maintained in good condition and remained at the target depth in the sediment during deployment. Of the six locations tested, no organisms were recovered from the two reference locations, and less than 31 grams of the original 120 grams of mass were recovered for each of the four locations adjacent to the Metal Bank Site. It is important to recognize that organism survival was not related to proximity to the Metal Bank

Site. Specifically, survival was lower in the references area than in some on-site areas. Table 6-5 presents the tissue mass retrieved from each of the testing chambers. Results from the 2012 study are similar to the previous year, which also saw high mortality and low mass recovery. Given the high mortality and lack of growth, the organisms retrieved from the test chambers were deemed to be inappropriate for bioaccumulation testing.

In support of the bioaccumulation study, sediment samples were also collected at the same six locations. Though the data have not yet been validated, results presented in Table 6-6 indicate that total PCBs in Site sediments are below the 1 ppm benchmark.

6.4.3 Benthic Community Survey

Comparison of the results between the Metal Bank Site and the reference area locations indicated similar invertebrate communities. All of the results showed communities primarily consisting of worms within a species complex in the genus *Limnodrilus* (Tol. = 10). Tolerant taxa were predominant at all sample locations. Summary statistics comparing the metrics calculated from the two areas are presented in Table 6-7. The results show considerable overlap between the Site and the reference areas, with no evidence of reduced diversity associated with the Site.

Compared to the results of the 2011 benthic community survey, the 2012 survey, which was conducted just one week following Hurricane Sandy, found a higher species richness at all six stations and similar invertebrate communities, Shannon Diversity and Hilsenhoff Index. These results suggest that Hurricane Sandy did not materially affect the structure of the benthic community. This point is further supported by the trends in daily discharge volume for the Delaware River at Trenton, presented in Illustration 5-1, which notes that flow velocities produced by Hurricane Sandy (marked by the orange vertical line) were modest compared to other events.

The complete results from the benthic community assessment are included in Appendix K. It is important to note that no specimens of the genus *Lumbriculus* were identified in the benthic community sampling.

6.5 Conclusions

- The results of the fish tissue monitoring provide no evidence that whole body fish tissue concentrations proximate to the Site are elevated above the 1 ppm threshold value nor are they elevated above local background values. The current fish tissue data is sufficient for USEPA's first 5-year review.
- The bioaccumulation testing conducted in June-July showed mortality lower at the Metal Bank Site than at the reference areas. The low growth and high mortality precluded the development of biota-sediment PCB accumulation factors from this data. The specific reasons for the high mortality and low growth, while uncertain, are likely related to the low oxygen, poor habitat quality, and exposure due to tidal fluctuations in water level. The results of the benthic community analysis show that the mudflat does not support a population of *Lumbriculus*, supporting the contention that this habitat is unlikely to support a healthy *Lumbriculus* population.

- Results of the sediment sampling conducted as part of the bioaccumulation study indicate that PCB concentrations in on-site sediments remain well below the LTM-threshold of 1 ppm.
- The results of the 2011 and 2012 benthic community assessments show that both the Site and the reference areas have a predominance of tolerant taxa. A fresh water intertidal mudflat is not expected to have high species diversity and is expected to be a low quality habitat. The finding of no significant differences between the Site and reference areas indicates that Site conditions do not correlate with a reduction in health of the benthic community.

7 Summary of Observations and Conclusions

The goal of this LTM program is to assess whether the constructed remedy is protective of human health and the surrounding environment. Specifically, the final constructed remedy was implemented to accomplish the following:

- Eliminate or substantially reduce the source of PCB contamination by excavating hot spots where the PCB contamination exceeded 25 ppm and transport these soils to an appropriately regulated receiving facility.
- Reduce exposure of PCB-impacted sediments to the aquatic environment by removing near-shore sediments exceeding a PCB concentration of 1 ppm and place the excavated sediments beneath the soil cap constructed on the upland portion of the Site.
- Prevent direct exposure to and surface erosion of residual soils containing low concentrations of PCBs by isolating these soils beneath a 2- to 4-ft soil cap over the upland portion of the Site.
- Prevent surface erosion of residual soils containing low concentrations of PCBs along the river banks from entering the adjacent aquatic environment by installing sheetpile walls along the Delaware River and tidal mudflat Site perimeter.
- Reduce exposure of PCB-impacted sediments to the aquatic environment by isolating offshore sediments with a PCB concentration exceeding 1 ppm beneath marine mattresses.
- Prevent LNAPL potentially containing PCBs from migrating in the subsurface environment and entering the adjacent tidal mudflat and Delaware River by removing recoverable LNAPL during the hot spot excavation and by installing an interceptor trench to monitor and recover LNAPL.

The various monitoring tasks of the LTM program were selected to ensure that the remedy components are functioning as designed and that the overall remedy is effective in meeting the goals of risk reduction. The data generated by the various monitoring tasks of the LTM program provide multiple lines of information that allow us to evaluate whether the constructed remedy is meeting the goals of risk reduction. Based on data collected during the construction and LTM phases, the following observations can be made:

- Significant sources of PCB contamination in the upland portion of the Site have been removed by excavating soils containing PCB concentrations in excess of 25 ppm which has been documented during construction and reaffirmed in the draft Engineer's Certification Report dated May 2010.
- Nearshore sediments containing PCB concentrations in excess of 1 ppm have been excavated and placed beneath the soil cap. This information has been documented during construction and reaffirmed in the draft Engineer's Certification Report dated May 2010.
- Soil cap inspections have not found any evidence of cracks, fissures, seeps, or settlement of the upland cap areas. In addition, the upland cap areas show no significant reduction in elevation compared to as-built conditions. Based on the combined visual and survey

information, the upland cap areas appear to be meeting their design objectives of preventing direct exposure to, and off-site migration of, contaminated soil particles.

- Based on the absence of sediments at the bottom of the Site outfalls, there is no evidence to suggest off-site sediment transport has occurred. In addition, vegetation levels exceed 80% Site-wide coverage and will continue to improve with time, further diminishing the potential for off-site sediment migration.
- Sheetpile wall inspections have not found any breaches in the wall or any significant wall deflections. Tilt of the wall is well below 2^{o} actionable level. Based on the combined visual and tilt meter information, the sheetpile walls appear to be meeting their design objectives of preventing off-site migration of contaminated soil particles into the aquatic environment.
- The epoxy-coated floor slab of Building 7 appears to be in good condition. No areas of exposed floor slab greater than 10 square centimeters have been observed. Based on the integrity of the epoxy coating, there is no pathway for direct exposure to PCB-contaminated slab materials.
- The mudflat backfill area and marine mattress inspections and surveys indicate no significant change in position or elevation. There is no indication that contaminated sediments are exposed at the Site or that off-site sediment transport is occurring; in fact, net sediment accumulation has been noted in the subaqueous cap areas.
- PCB LNAPL has not been observed in the monitoring trench. In addition, there are no significant concentrations of contaminants of concern in Site groundwater. While there are no actionable groundwater thresholds for the Site, the contaminants that have been detected, such as PCBs and dioxins, have been found at levels well below USEPA drinking water standards. Based on the above, groundwater transport appears to be a negligible migration pathway for Site contaminants.
- Biological monitoring activities, including fish tissue, benthic community, and bioaccumulation studies have failed to demonstrate any significant difference between conditions near the Metal Bank Site and conditions at reference locations, and sediment PCB concentrations at the Site are below actionable levels.

Based on the information collected during the construction and LTM phases, we conclude that the remedy is functioning as intended and is meeting the goal of overall risk reduction.

8 References

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Tables

Table 2-1. Approach to Long-Term Groundwater Monitoring

Monitoring Task	Frequency	Action Trigger	Action
Collect groundwater samples and elevation data from 6 on-site monitoring wells	Quarterly for first 2 years[a] (reduced in subsequent years)	5 years of monitoring data available	Perform statistical trend analysis on groundwater data
Monitor groundwater elevations on 6 on-site monitoring wells	Same as above, plus following rain events greater than 4 inches in 24 hours, or 100-year flood events	Water elevations greater than soil cap elevation (11 ft above msl)	Collect and analyze soil samples for PCBs (Aroclor) to evaluate potential upward LNAPL migration into soil cap.

[a] Reduced to semiannual after five rounds of sampling

msl: mean sea level

PCB: polychlorinated biphenyl

LNAPL: light nonaqueous phase liquids

ft :feet

Table 2-2. Activities Performed for Long-Term Groundwater Monitoring

No.	Date	Groundwater Monitoring	Rationale
1	26-29-Jul-10	✓	3rd Quarter 2010 - Quarterly Monitoring
2	18-19-Oct-10	✓	4th Quarter 2010 - Quarterly Monitoring
3	10-13-Jan-11	✓	1st Quarter 2011 - Quarterly Monitoring
4	11-13-Apr-11	✓	2nd Quarter 2011 - Quarterly Monitoring
5	25-27-Jul-11	✓	3rd Quarter 2011 - Quarterly Monitoring
6	26-27-Oct-11	✓	4th Quarter 2011 - Semi-Annual Monitoring
7	24-25-Apr-12	✓	2nd Quarter 2012 - Semi-Annual Monitoring
8	17-18-Oct-12	✓	4th Quarter 2012 - Semi-Annual Monitoring

Table 2-3. Groundwater Summary Statistics

Group	Number Analyzed	% Detects[a]	Max Result	Compound	Well	Date	Mean[c]
Dioxin/ Furans	357	16%	700[b] J pg/L	Octachloro dibenzo-p-dioxin	MW-06	Q3 2011	170 pg/L
Congeners	8778	64%	68.6 ng/L	PCB-206	MW-03	Q3 2010	4.4 ng/L
Aroclors	504	2%	0.202 J µg/L	Aroclor-1268	MW-03	Q1 2011	0.039 µg/L
SVOCs	2275	12%	1,070 µg/L	Naphthalene	MW-05	Q3 2010	140 µg/L

[a] Counts only those detections greater than the practical quantitation limit

[b] A concentration of 3,520 pg/L was encountered in January 2011, however, this sample was qualified “B,” indicating the presence of the contaminant in a blank.

[c] Means reported here apply only to the compound with the highest detection ('Compound'). The mean is calculated as the average of the mean compound concentration in each of the six on-site wells for all sampling events since 2010. "B"-qualified results are excluded from the calculation. Results below the detection limit are incorporated using a value of one half the detection limit.

µg/L: microgram(s) per liter
J: estimated value
ng/L nanogram(s) per liter
pg/L: picogram(s) per liter
Q: quarter

Table 3-1. Approach for Long-Term LNAPL Trench Monitoring

Monitoring Task	Frequency	Action Trigger	Action
Visually observe LNAPL trench for the presence of a sheen or product layer (using interface probe if warranted)	Bi-weekly in first quarter, quarterly thereafter	LNAPL (oil) observed in trench	Use adsorbent booms or active pumping to remove oil
Monitor water elevation in LNAPL trench sumps	Same as above, plus following rain events greater than 4 inches in 24 hours or 100-year flood events.	Water elevations greater than soil cap elevation (11 ft msl)	Collect and analyze soil samples for PCBs (Aroclor) to evaluate potential upward LNAPL migration into soil cap.

ft: feet
LNAPL: light nonaqueous phase liquids
msl: above mean sea level
PCB: polychlorinated biphenyl

Table 3-2. Activities Performed for Long-Term LNAPL Trench Monitoring

No.	Date	Subtask 1 Visual Observation	Subtask 2 Groundwater Elevations	Rationale
Post-Construction Period				
1	31-Mar-10	✓	✓	2nd Quarter 2010 - Bi-weekly Monitoring
2	14-Apr-10	✓	✓	2nd Quarter 2010 - Bi-weekly Monitoring
3	28-Apr-10	✓	✓	2nd Quarter 2010 - Bi-weekly Monitoring
4	12-May-10	✓	✓	2nd Quarter 2010 - Bi-weekly Monitoring
5	27-May-10	✓	✓	2nd Quarter 2010 - Bi-weekly Monitoring
6	9-Jun-10	✓	✓	2nd Quarter 2010 - Bi-weekly Monitoring
7	23-Jun-10	✓	✓	2nd Quarter 2010 - Bi-weekly Monitoring
Long-Term Monitoring Period				
8	7-Jul-10	✓	✓	3rd Quarter 2010 - Quarterly Monitoring/ Final Bi-weekly Monitoring
9	11-Nov-10	✓	✓	4th Quarter 2010 - Quarterly Monitoring
10	10-Jan-11	✓	✓	1st Quarter 2011 - Quarterly Monitoring
11	11-Apr-11	✓	✓	2nd Quarter 2011 - Quarterly Monitoring
12	25-Jul-11	✓	✓	3rd Quarter 2011 - Quarterly Monitoring
13	27-Oct-11	✓	✓	4th Quarter 2011 - Quarterly Monitoring
14	13-Jan-12	✓	✓	1st Quarter 2012 - Quarterly Monitoring
15	25-Apr-12	✓	✓	2nd Quarter 2012 - Quarterly Monitoring
16	17-Jul-12	✓	✓	3rd Quarter 2012 - Quarterly Monitoring
17	18-Oct-12	✓	✓	4th Quarter 2012 - Quarterly Monitoring

LNAPL: light nonaqueous phase liquid

Table 4-1. Approach to the Upland Inspections

Monitoring Task	Frequency	Action Trigger	Action
A. Erosion and Sediment Control			
Condition Survey - visual inspection of E&S control measure integrity	Quarterly and following 25-year storm event	Signs of sediment transport and/or damage to existing E&S control measures	Notify USEPA and perform required maintenance or repair activities to restore E&S control measures
B. Vegetated Soil Cap			
1. Condition Survey - visual inspection of overall cap integrity	Quarterly and following 25-year storm event	Signs of settlement, fissures/cracks, erosion, and or seeps noted	Notify USEPA and perform required maintenance or repair activities to restore cap integrity
2. Elevation survey of capped areas	Annually (changed to one post-establishment survey and once every five years thereafter - USEPA letter 2/9/12)	Material decrease in cap thickness	Notify USEPA and perform required activities to restore cap thickness to original design specifications
3. Vegetation Survey	Semi-annually in late spring and late summer for first two years (annually in mid-summer thereafter)	Less than 80% vegetative cover, bare areas, or greater than 10% invasive plant species	Notify USEPA and perform required maintenance activities, including reseeding and compost application to increase vegetative cover or herbicide application to reduce invasive species. See also Mowing (below)
4. Mowing	In second spring, every three years thereafter, and as needed to control woody species (outside of bird nesting season)	1.Second spring after seeding or when vegetation height exceeds 18”	1. Mow in weave pattern to 4”-8” (outside of nesting season)
		2. Every three years thereafter	2. Mow in weave pattern to 6”-8” (outside of nesting season)
		3.Caliper >0.5”	3.Remove woody species
		4. Invasive species	4.Mow as needed in addition to herbicide application
C. Building 7			
Condition Survey - visual inspection of epoxy-coated floor slab	Annually in spring	Exposed concrete >10 cm^2 surface area	Notify USEPA and reapply epoxy coating to exposed areas of concrete
D. Sheetpile Wall			
Sheetpile wall condition survey and tilt/rotation measurements	Monthly for six months; quarterly thereafter	Greater than 2^o sheetpile wall rotation in first two years	Notify USEPA and perform required activities to stabilize the sheetpile wall. If rotation <2^o after two years monitoring will cease.

cm2: square centimeters
E&S: erosion and sediment
USEPA: United States Environmental Protection Agency

Table 4-2. Activities Performed for Long-Term Upland Monitoring

No.	Date	Rationale	Notes / Observations
A. Erosion and Sediment Control			
1 Notice	9-Jun-10	Notice	Provided USEPA notice of upcoming bi-weekly inspection scheduled for June 23, 2010
Meeting	17-Jun-10	Meeting at USEPA Office	USEPA, CDM, Group, and MPI met at USEPA offices regarding transition to LTM and with storm event E&S surveys, the movement of bi-weekly Site inspections to quarterly, and vegetation inspection of 6/23/10 were several of the items discussed.
1	23-Jun-10	Final post-construction Inspection prior to start of LTM	USEPA (Z. Swavely – CDM), Enviroscapes, and MPI conducted the assessment of the vegetative cover and potential path forward activities for vegetative cover. The Site visit focused on the vegetative cover..
Milestone	**1-Jul-10**	**Official Start of LTM**	**Per meeting with USEPA on 6/17/10 and 5/26/10 response to USEPA comments on 5/13/10 conditional approval of LTM**
2 Notice	23-Sep-10	Notice	USEPA provided notice of upcoming inspection scheduled for September 28, 2010 with PADEP
2	28-Sep-10	Quarterly inspection – 2010 Q3	Noted significant erosion along the southern edge of the southern mudflat outfall, and some of the silt fence was down along the western portion of the property. USEPA and PADEP were present on Site.
2-R	26-27-Oct-10	Repairs (see 9/28 inspection)	Installed additional stone in the southern drainage swale on the east side of the Site and made repairs to the silt fence along the western property boundary per the USEPA email of 9/30/10.
3 Notice	16-Dec-10	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for January 4, 2011
3	4-Jan-11	Quarterly inspection –	Site covered in snow – no E&S observations possible.
Pre-4	23-Feb-11	USEPA and City of Philadelphia conduct an E&S inspection shortly after snow melt	Sediments noted near top of outfall structures, perimeter E&S controls worn, and areas of the Site appearing unstable.
4 Notice	9-Mar-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for March 15, 2011.
4	15-Mar-11	Quarterly inspection – 2011 Q1	Observations similar to February 23 Inspection. E&S measures worn but functional. Repairs and adjustments needed. USEPA and PWD present on-site.
4-Plan	12-Apr-11	Group submits plan to deal with E&S issues identified in March 15 inspection and in response to USEPA March 22 comment letter (USEPA 2011a)	Group proposes to remove and replace wattle material along the fence line and entrance, replace hay bales as necessary along the perimeter of Outfall #1 and #2, install AASHTO No. 1 at the edge of pavement to create an entrance tire scrubber for field vehicles entering the southern area of the Site, install drainage improvements between the southern sheetpile return wall and Outfall #2, remove sediment and install additional R-3 stone and replace perimeter wattle material in Outfall #3, and remove sediment and re-install wattle material along the perimeter of Outfall #4.
4-Plan Apprv	4-May-11	USEPA provides notice to proceed with sediment & erosion control measures proposed in April 12 letter.	USEPA recommended the use of straw or compost logs and its preference for consideration of woody species at the entrances to the outfalls.
4-R Notice	9-May-11	Notice	Provided USEPA notice of upcoming repairs scheduled to commence on May 16, 2011.
5 Notice	9-May-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for May 17, 2011
4-R	16-23-May-11	Repairs (see 5/4 plan approval)	Executed the corrective measure construction per the 4/12/11 letter and USEPA approval of 5/4/11.
5	17-May-11	Quarterly inspection – 2011 Q2	No additional E&S issues noted. USEPA present on-site.
6 Notice	15-Aug-11	Notice	Provided USEPA notice of upcoming Quarterly inspection scheduled for August 17, 2011.
6	17-Aug-11	Quarterly inspection – 2011 Q3	Inspection coincided with sheetpile wall monitoring.
7 Notice	26-Aug-11	Notice	Provided USEPA notice of upcoming Special inspection (post-Irene) scheduled for August 29, 2011.

Table 4-2. Activities Performed for Long-Term Upland Monitoring

No.	Date	Rationale	Notes / Observations
7	29-Aug-11	Post-Irene Site inspection	Post-hurricane Irene. Observed and repaired a small (< 20 ft.) section of silt fence near the Cottman Avenue gate.
8 Notice	10-Oct-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for October 27, 2011.
8	27-Oct-11	Quarterly inspection – 2011 Q4	Conducted quarterly inspection of E&S control measures. No issues identified.
8-R Notice	10-Dec-11	Notice	Provided USEPA notice of upcoming repairs scheduled to commence on December 26-27, 2011.
8-R	26/27-Dec-11	Repairs (see 10/27 inspection)	Executed repairs and provided a copy of the field report to USEPA on January 10, 2012.
9	13-Jan-12	Quarterly inspection – 2012 Q1	Conducted quarterly inspection of E&S control measures. No issues identified.
10 Notice	10-Apr-12	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for April 24, 2012.
10	24-Apr-12	Quarterly inspection – 2012 Q2	Some silt fence posts have fallen over. In addition, some silt fence has been crushed by debris from Revolution Recovery and a 20-ft section of silt fence on the northeast side is ripped. Repairs are required.
10-R Notice	10-May-12	Notice of repairs	Provided USEPA notice of upcoming minor E&S repairs scheduled for May 16, 2012.
10-R	18-May-12	Repairs (see 4/24 inspection)	Repaired silt fence damage noted during 4/24 inspection.
11	17-Jul-12	Quarterly inspection – 2012 Q3	Conducted quarterly inspection of E&S control measures. No issues identified.
12 Notice	10-Oct-12	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for October 15-17, 2012.
13 Notice	10-Oct-12	Notice	Provided USEPA notice of upcoming 5-year review inspection scheduled for October 23, 2012.
12	18-Oct-12	Quarterly inspection – 2012 Q4	A portion of the silt fence has fallen down. It was fixed by Lewis Environmental. No further repairs are necessary.
13	23-Oct-12	5-Year Review Inspection	No E&S action items.
14 Notice	29-Oct-12	Notice	Provided USEPA notice of upcoming post-Sandy Site inspection scheduled for November 1 or 2, 2012.
14	1-Nov-12	Post-Sandy Site inspection	Conducted inspection of E&S control measures. No issues identified.
B. Vegetated Soil Cap – (1) Cap Integrity			
1 Notice	9-Jun-10	Notice	Provided USEPA notice of upcoming bi-weekly inspection scheduled for June 23, 2010.
Meeting	17-Jun-10	Meeting at USEPA office	USEPA, CDM, Group, and MPI met at USEPA offices regarding transition to LTM and with storm event E&S surveys, the movement of bi-weekly Site inspections to quarterly, and vegetation inspection of 6/23/10 were several of the items discussed.
1	23-Jun-10	Final post-construction Inspection prior to start of LTM	USEPA (Z. Swavely – CDM), Enviroscapes, and MPI conducted the assessment of the vegetative cover and potential path forward activities for vegetative cover. Vegetation is growing or beginning to emerge on most of the capped area of the Site. However, significant portions of the southern area and an area to the north of Building 7 have little to no vegetation growing. Invasive species, such as Japanese Knotweed and Phragmites, were observed outside of the cap area along the perimeter of the Site. Enviroscapes informed the meeting attendees that the specified seed mix is a summer mix that requires an extended period of warm soil temperatures before a significant amount of plants will emerge and that it normally takes two to three years to establish a vegetative cover using this seed mix. He also presented documents verifying this, including statements in the Ernst seed catalogue. Enviroscapes also pointed out that there has been little rain recently so plants could be slow to emerge due to the lack of water. Provide a plan to USEPA for reseeding of the Site (targeted for mid to late July 2010) and elimination of invasive plant species (August 2010)

Table 4-2. Activities Performed for Long-Term Upland Monitoring

No.	Date	Rationale	Notes / Observations
Milestone	**1-Jul-10**	**Official start of LTM**	**Per meeting with USEPA on 6/17/10 and 5/26/10 response to USEPA comments on 5/13/10 conditional approval of LTM**
2 Notice	23-Sep-11	Notice	USEPA provided notice of upcoming inspection scheduled for September 28, 2010 with PADEP.
2	28-Sep-10	Quarterly inspection – 2010 Q3	Did not observe any signs of settlement, cracks, fissures, or seeps. Indirect effects of cap erosion noted at perimeter. USEPA and PADEP present on-site.
3 Notice	16-Dec-10	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for January 4, 2011
3	4-Jan-11	Quarterly inspection – 2010 Q4	Site covered in snow – no cap integrity observations possible.
Pre-4	23-Feb-11	USEPA and City of Philadelphia conduct an E&S inspection shortly after snow melt	Indirect signs of cap erosion noted by PWD, USEPA, and PADEP.
4 Notice	9-Mar-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for March 15, 2011.
4	15-Mar-11	Quarterly inspection – 2011 Q1	Observations similar to February 23 Inspection. USEPA and PWD present on-site.
5 Notice	9-May-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for May 17, 2011.
5	17-May-11	Quarterly inspection – 2011 Q2	Did not observe any signs of settlement, cracks, fissures, seeps, or erosion. USEPA present on-site.
6 Notice	15-Aug-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for August 17, 2011
6	17-Aug-11	Quarterly inspection – 2011 Q3	Inspection coincided with sheetpile wall monitoring
7 Notice	26-Aug-11	Notice	Provided USEPA notice of upcoming Special inspection (post-Irene) scheduled for August 29, 2011.
7	29-Aug-11	Post-Irene site inspection	Post-Irene. Did not observe any signs of settlement, cracks, fissures, seeps, or erosion.
8 Notice	10-Oct-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for October 27, 2011.
8	27-Oct-11	Quarterly inspection – 2011 Q4	No issues related to E & S Control.
9	13-Jan-12	Quarterly inspection – 2012 Q1	Did not observe any signs of settlement, cracks, fissures, seeps, or erosion.
10 Notice	10-Apr-12	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for April 24, 2012.
10	24-Apr-12	Quarterly inspection – 2012 Q2	Some ruts were visible. They will be hand-graded so as not to disturb the vegetation. No other signs of settlement, cracks, fissures, seeps, or erosion.
11	17-Jul-12	Quarterly inspection – 2012 Q3	Previously noted ruts were hand-graded. Did not observe any signs of settlement, cracks, fissures, seeps, or erosion.
12 Notice	10-Oct-12	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for October 15-17, 2012.
13 Notice	10-Oct-12	Notice	Provided USEPA notice of upcoming 5-year review inspection scheduled for October 23, 2012.
12	18-Oct-12	Quarterly inspection – 2012 Q4	Did not observe any signs of settlement, cracks, fissures, seeps, or erosion.
13	23-Oct-12	5-Year Review Inspection	No E&S action items.
14 Notice	29-Oct-12	Notice	Provided USEPA notice of upcoming post-Sandy Site inspection scheduled for November 1 or 2, 2012.
14	1-Nov-12	Post-Sandy Site inspection	Did not observe any signs of settlement, cracks, fissures, or seeps. Areas of minor erosion were observed along the berm in the southeast area of the Site.
B. Vegetated Soil Cap – (2) Cap Survey			
1	8/10-Dec-10	Post construction survey	Survey results indicated no material change in cap thickness since 2009 as-built survey (<0.2% difference). Depending on data interpolation method change in cap thickness ranges from +0.20% to -0.12%.

Table 4-2. Activities Performed for Long-Term Upland Monitoring

No.	Date	Rationale	Notes / Observations
Letter	9-Feb-12	USEPA letter	USEPA concludes that cap erosion may have occurred and requests a soil cover thickness assessment.
2 Notice	10-May-12	Notice	Provided USEPA notice of upcoming upland cap monitoring and cap thickness assessment.
2	23/25-May-12	Upland survey and cap thickness assessment	Survey results were similar to previous surveys, indicating that erosion to date has been minimal. The upland cap thickness continues to meet design requirements. USEPA contractor on-site.
B. Vegetated Soil Cap – (3) Vegetation Monitoring, and (4) Mowing			
1 Notice	9-Jun-10	Notice	Provided USEPA notice of bi-weekly inspection scheduled for June 9, 2010
1	9-Jun-10	Bi-weekly inspection	Note invasive species around perimeter of the Site. Significant portions of the southern area and an area north of Building 7 have little or no vegetation growing.
Meeting	17-Jun-10	Meeting at USEPA office	USEPA, CDM, Group, and MPI meet at USEPA offices regarding transition to LTM and with storm event E&S surveys, the movement of bi-weekly Site inspections to quarterly, and vegetation inspection of 6/23/10 were several of the items discussed.
1b Notice	17-Jun-10	Notice	Provided USEPA notice of upcoming vegetative cover assessment scheduled for June 23, 2010.
1b	23-Jun-10	Final post-construction inspection prior to start of LTM and semiannual vegetation assessment	Group and USEPA note invasive species around perimeter of the Site. Significant portions of the southern area and an area north of Building 7 have little or no vegetation growing.
1b Plan	29-Jun-10	Reseeding plan	Group submits plan for reseeding and elimination of the invasive plant species on the Site (See 6/23/2010 inspection).
Milestone	**1-Jul-10**	**Official start of LTM**	**Per meeting with USEPA on 6/17/10 and 5/26/10 response to USEPA comments on 5/13/10 conditional approval of LTM**
1b-R Notice	4-Aug-10	Notice	Provided USEPA notice of upcoming reseeding scheduled for August 12-13, 2010.
1b-Ra	12-13-Aug-10	Reseeding	Reseeded entire vegetative cover with Ernst 123 using a Truax drill seeder.
1b-Rb	27-Aug-10	Invasives - herbicide application	Applied USEPA-approved herbicide to phragmites and knotweed at fence line along Milnor Street and Cottman Avenue, eastern boundary, and the Delaware River stream bank at the southern end of the southern cap.
1b-Rc	22-23-Sep-10	Invasives – mechanical removal	Mechanically remove herbicide treated invasives along Site perimeter.
	28-Sep-10	Inspection by USEPA and PADEP with MPI	USEPA and PADEP indicated their perspective of lack of vegetation on cap.
2	11-Oct-10	Internal meeting with Ernst and Enviroscapes based on Sept 28, 2010 meeting with USEPA and PADEP	Group meets with seed mix provider to assess vegetation growth relative to expectations of the conditions to date.
Letter	25-Oct-10	USEPA letter	USEPA documents their position on the lack of vegetation on the cap and directs Group to provide a corrective measures plan to stabilize the cover.
2 Plan	18-Nov-10	Reseeding plan / notice	Presented seed mix provider's plan to USEPA to improve vegetation condition at the Site. Propose reseeding with a cover crop and reassessing after 2011 growing season. Work is proposed to commence on December 8, 2010.
2- Plan Appr.	23-Nov-10	Approval of reseeding plan	USEPA approves reseeding plan
2-R	8-Dec-10	Reseeding	Re-seeded with cover crop per 11/18 plan. Provide USEPA with documentation upon completion (12/9)

Table 4-2. Activities Performed for Long-Term Upland Monitoring

No.	Date	Rationale	Notes / Observations
3 Notice	May-11 and 9-Jun-11	Notice	Provided USEPA notice of upcoming vegetation assessment scheduled for June 10, 2011 (at meeting of 5/11 and email of USEPA meeting minutes on 6/9/11).
3	10-Jun-11	Semiannual vegetation assessment	USEPA, Group, and seed mix provider performed vegetation assessment. Vegetation in most areas greater than 24". Some specific areas have poor establishment of vegetative cover. Seed mix provider suggests mowing and addressing areas of poor cover.
3 Plan	14-Jul-11	Mowing plan /notice	Proposed to implement seed mix provider recommendations made at 6/10 Site visit. Propose start date of 7/21/11.
3 Plan Appr.	18-Jul-11	Approval of mowing plan	USEPA approved proposed plan and requests notice. In addition, USEPA requests vegetative cover plan by 7/27/2011
3-R Notice	18-Jul-11	Notice	Provided USEPA notice of upcoming mowing activities scheduled for July 21, 2010
3-R	21-Jul-11	Mowing	Complete mowing per approved approach communicated to USEPA on 7/14. Provide USEPA with update upon mowing completion (7/22/2011).
3-R Plan	25-Jul-11	Vegetative cover plan	Group provided USEPA with an overall vegetative cover plan including key LTM aspects, technical information from seed mix provider regarding the 2-3 year duration for native seed establishment, previously performed corrective measures, new short-term corrective measures, long-term mowing plan, LTM and inspections, and application of fertilizers/water/herbicides.
4 Notice	23-Sep-11	Notice	Provided USEPA notice of upcoming vegetation assessment scheduled for September 27, 2011.
4	27-Sep-11	Semiannual vegetation assessment	USEPA and Group met on-site to observe the condition of the vegetation and to discuss (1) the need for mowing, and (2) the areas to be rehabilitated through the addition of compost and new seed. Vegetation observed >24" tall requiring mowing. Compost and seed to be added to certain areas and areas where previous vehicular traffic compacted soil.
4 Plan	28-Sep-11	Compost approval	USEPA approved source of compost.
4 Plan	29-Sep-11	Vegetation rehabilitation plan	Group provided comments to USEPA regarding extent of areas to be composted and reseeded and the mowing prior to composting/reseeding
4 Plan Appr.	28/30-Sep-11	Approval of rehabilitation Plan	USEPA approves rehabilitation plan.
4-R Notice	29-Sep-11	Notice	Provided USEPA notice of upcoming vegetation cutting scheduled for October 10-11, 2011.
4-R	10/11-Oct-11	Mowing/rehabilitation	Mowed site prior to implementing rehab plan. Added compost and reseeded the Site in accordance with the USEPA-approved vegetation rehabilitation plan (9/29)
Letter	19-Oct-11	Vegetation plan moving forward	USEPA issued letter to Group responding to the 9/29/11 response to comments along with the vegetative cover plan of 7/25/11. USEPA requests that the long-term plan address woody species and a vegetative cutting plan every three years, enhance the invasive species control strategy, and revision of the vegetation plan of the LTM to incorporate USEPA recommendations.
4-R Plan	9-Jan-12	Vegetative cover plan	Submit second revision of vegetative cover plan to USEPA
5 Notice	10-Apr-12	Notice	Provided USEPA notice of upcoming vegetation inspection scheduled for October May 23, 2012.
5	23-May-10	Annual Vegetation Inspection	Attended by USEPA. Overall vegetative cover is good, though some sparsely vegetated areas remain. These areas will be addressed.
5 B	30/31-May-12	Complete Vegetation Survey/Inspection	Completed the Site-wide vegetation inspection for invasive species and vegetative cover.
5 Report	26-Jun-12	Submit Vegetative Cover Inspection report	Site-wide average vegetative cover >80% (though some areas are sparsely vegetated and will be addressed), and invasive species <10% (though management options are being considered).

Table 4-2. Activities Performed for Long-Term Upland Monitoring

No.	Date	Rationale	Notes / Observations
5-R Plan A	19-Jul-12	Invasive Species Control Plan	Outlines approach to invasive species control. Recommends combination of mowing and herbicide application. Herbicide application scheduled for late August/early September. USEPA approval needed.
5-R Plan A,B Notice	24-Jul-12	Notice	Provide USEPA with preliminary schedule for seeding/mowing/herbicide application
5-R Plan B	10-Aug-12	Propose seed/amendment mix to use on sparse areas	USEPA approval pending.
5-R Plan B Appr.	11-Sep-12	EPA approves seed/amendment mix	USEPA approves seed/amendment mix.
5-R B	1/2-Oct-12	Mowing/reseeding	Mowed entire Site and reseeded sparsely vegetated areas identified during May 23, 2012 vegetation inspection, using seed/amendment mix approved on Septemeber 11, 2012. Due to the timing of USEPA's herbcide application approval, we will not be able to apply herbicide until Spring 2013 (see Invasive Species Comtrol Plan 7/19/2012).
6 Notice	10-Oct-12	Notice	Provided USEPA notice of upcoming 5-year review inspection scheduled for October 23, 2012.
6	23-Oct-12	5-Year Review Inspection	Grass needs to be cut between Site perimeter and fence, and cuttings may possibly need to be removed if found to negatively affect vegetative growth.
6-R	30-Nov-12	Mowing	Cut the grass between the Site perimeter and fence, as identified during the 5-year review.
C. Building 7			
1 Notice	11-May-10/25-May-10	Notice	Provided USEPA notice of biweekly inspections scheduled for May 12 and May 26, respectively.
1	12-May-10/26-May-10	Bi-weekly inspections	Conducted inspection of Building 7.
2	17-May-11	Quarterly inspection – 2011 Q2	Noted a large chip of epoxy outside of the southeastern corner of the containment area. Area along west wall of Building needs to be monitored/ reinspected No exposed floor slab noted.
3 Notice	26-Aug-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for August 29, 2011.
3	29-Aug-11	Quarterly inspection – 2011 Q3	Post-Irene. No exposed floor slab noted.
4 Notice	10-Oct-11	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for October 27, 2011.
4	27-Oct-11	Quarterly inspection – 2011 Q4	No exposed floor slab noted.
5	13-Jan-12	Quarterly inspection – 2012 Q1	Much of the floor covered in water. Unable to fully assess the state of the epoxy coating.
6 Notice	10-Apr-12	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for April 24, 2012.
6	24-Apr-12	Quarterly inspection – 2012 Q2	Some cracks were visible, but no exposed floor slab was noted.
7	17-Jul-12	Quarterly inspection – 2012 Q3	Some cracks were visible, but no exposed floor slab was noted.
8 Notice	10-Oct-12	Notice	Provided USEPA notice of upcoming quarterly inspection scheduled for October 15-17, 2012.
9 Notice	10-Oct-12	Notice	Provided USEPA notice of upcoming 5-year review inspection scheduled for October 23, 2012.
8	18-Oct-12	Quarterly inspection – 2012 Q4	Some cracks were visible, but no exposed floor slab was noted.
9	23-Oct-12	5-Year Review Inspection	No cracks in the epoxy coated floor were greater than 100 square centimeters, requiring repair with patch coating.

Table 4-2. Activities Performed for Long-Term Upland Monitoring

No.	Date	Rationale	Notes / Observations
D. Sheetpile Wall			
1	24-Aug-10	Monthly inspection – Month 1	Sheetpile in good condition – no material tilt/rotation observed or measured.
2	28-Sep-10	Monthly inspection – Month 2	Sheetpile in good condition – no material tilt/rotation observed or measured.
3	26-Oct-10	Monthly inspection – Month 3	Sheetpile in good condition – no material tilt/rotation observed or measured.
4	2-Dec-10	Monthly inspection – Month 4	Sheetpile in good condition – no material tilt/rotation observed or measured.
5	2-Jan-11	Monthly inspection – Month 5	Sheetpile in good condition – no material tilt/rotation observed or measured.
6	3-Feb-11	Monthly inspection – Month 6	Sheetpile in good condition – no material tilt/rotation observed or measured.
7	17-May-11	Quarterly inspection – 2011 Q2	Sheetpile in good condition – no material tilt/rotation observed or measured.
8	17-Aug-11	Quarterly inspection – 2011 Q3	Sheetpile in good condition – no material tilt/rotation observed or measured.
9	16-Nov-11	Quarterly inspection – 2011 Q4	Sheetpile in good condition – no material tilt/rotation observed or measured.
10	13-Jan-12	Quarterly inspection – 2012 Q1	Sheetpile in good condition – no material tilt/rotation observed or measured.
11	25-Apr-12	Quarterly inspection – 2012 Q2	Sheetpile in good condition – no material tilt/rotation observed or measured.
12	17-Jul-12	Quarterly inspection – 2012 Q3	Sheetpile in good condition – no material tilt/rotation observed or measured. Two-year monitoring period completed per LTM requirements.
13	23-Oct-12	5-Year Review Inspection	No deflections or separations of individual steel sheets. No rust or corrosion visible. Previous repairs continue to function. Slight bulging of western return wall. Small gullies in soils near tiebacks, and potential stress cracks in upland soils 50 ft from the wall.
14	27-Nov-12	Follow-up Sheetpile Wall Inspection	Complete inspection results pending

CDM: Camp Dresser McKee

E&S: erosion and sediment

LNAPL: light non-aqueous liquids

LTM: long-term monitoring report

MPI: Malcolm Pirnie

PADEP: Pennsylvania Department of Environmental Protection

PWD: Philadelphia Water Department

Q: quarter

USEPA: United States Environmental Protection Agency

Table 5-1. Approach to the Mudflat Backfill, Marine Mattress, and Sediment Accumulation Inspections

Monitoring Task	Frequency	Action Trigger	Action
A. Mudflat Backfill			
Visually inspect mudflat backfill at low tide and perform elevation survey	Annually plus after anthropogenic disturbance or 25-year storm event (visual only)	Damage or proximal erosion noted	Provide advance notification to USEPA and implement backfill and/or marine mattress repairs/maintenance
B. Marine Mattresses			
Visually inspect marine mattresses (divers) and perform bathymetric survey	Annually plus after anthropogenic disturbance or 25-year storm event (visual only) As of 2/9/2012 changed to every 5 years plus within 60 days of tidal current velocities in excess of 125 cm/s at Trenton, NJ.	Damage or proximal erosion noted or mattress separation > 6”	Provide advance notification to USEPA and implement backfill and/or marine mattress repairs/maintenance
C. Sediment Accumulation			
Visually evaluate sediment accumulation in backfill areas at low tide, and measure subaqueous cap sediment thickness using divers	Annually	> 12” of accumulation noted	Perform future bioaccumulation tests on backfill and subaqueous cap areas

cm/s: centimeters per second
USEPA: United States Environmental Protection Agnecy

Table 5-2. Activities Performed for Mudflat Backfill, Marine Mattress, and Sediment Accumulation Inspections

No.	Date	Mudflat	Marine Mattress	Sediment	Rationale
1	Nov-10	✓	✓	✓	Annual Monitoring - 2010
2	4-5-Jun-12	✓	✓	✓	Annual Monitoring - 2012
3	27-Nov-12	✓	✓		Annual Monitoring - 2012 (visual only)

Table 6-1. Approach to the Biological Monitoring Component of Long-Term Monitoring

Monitoring Task	Frequency	Action Trigger	Action
A. Fish Study			
Perform fish study at 3 nearshore locations, 1 upstream location and 1 downstream location. Target species are mummichog and spotfin shiner/silvery minnow. Eels will be analyzed if caught.	Single sampling event	1. Fish tissue concentrations greater than 1 ppm total PCBs Aroclor on a wet weight basis	1. Perform congener analysis on the fish tissue
B. Bioaccumulation Study			
Perform bioaccumulation study on *Lumbriculus variegatus* at 4 mudflat locations and 2 reference locations	Annually for two years	1. Sediment PCB results > 1 ppm at on-site locations	1. Submit recommendation to USEPA for further action
		2. Site tissue data > prior data	2. Perform additional studies
		3. Site tissue concentration > reference site data	3. Perform additional studies
C. Community Structure Study			
Perform benthic community survey at 4 mudflat locations and 2 reference locations	Annually for two years	Significant community structure differences between on-site and reference locations (more tolerant taxa)	Discuss potential follow-up studies with USEPA

PCB: polychlorinated biphenyl
ppm: parts per million
USEPA: United States Environmental Protection Agency

Table 6-2. Activities Performed the Biological Monitoring Component of Long-Term Monitoring

No.	Date	Activity	Rationale
1	31-May-11 to 2-Jun-11	Collect fish from the Delaware River	Single sampling event
2	29-Jun-11 to 28-Jul-2011	Place lumbriculus samples into test chambers at Site and reference locations and retrieve samples 29 days later.	First of two annual planned sampling events
3	16-17-Nov-11	Four site and two upstream sediment samples were collected containing benthic organisms to be evaluated as part of the survey	First of two annual planned sampling events
4	29-30-May-12	Collect sediments to support the in situ bioaccumulation study	Second of two annual planned sampling events
5	10-12-Jul-12	Collect fish from the Delaware River	Single sampling event (#2)
6	19-Jun-12 to 18-Jul-12	Place lumbriculus samples into test chambers at Site and reference locations and retrieve samples 28 days later.	Second of two annual planned sampling events
7	5-Nov-12	Four Site and two upstream sediment samples were collected containing benthic organisms to be evaluated as part of the survey	Second of two annual planned sampling events

Table 6-3. Fish Monitoring Program Results

Year	Sample ID	Location	Group Aroclor Results Wet Weight Basis Total (mg/kg)	USEPA Congener Results[a] Wet Weight Basis Total (mg/kg)
2011	S1-TB-BK	Tacony Palymra Bridge	0.058	0.13
	S1-TB-SM	Tacony Palymra Bridge	0.070	0.11
	S1-TB-SMA	Tacony Palymra Bridge	NA	NA
	S1-TB-SS	Tacony Palymra Bridge	0.13	NA
	S2-MB-MC	Metal Bank	0.082	0.24
	S2-MB-SM	Metal Bank	0.14	0.091
	S3-MB-BK	Metal Bank	0.050	0.10
	S4-MB-BK	Metal Bank	0.050	NA
	S5-PC-BK	Pennypack Creek	0.038	0.22
	S5-PC-BKA	Pennypack Creek	NA	0.15
	S5-PC-MC	Pennypack Creek	0.014	0.12
	S5-PC-SM	Pennypack Creek	0.13	NA
2012	ST1-TP-BK	Tacony Palymra Bridge	0.88	
	ST1-TP-ESM	Tacony Palymra Bridge	0.82	
	ST2-MB-BK	Metal Bank	0.16	
	ST2-MB-ESM	Metal Bank	0.40	
	ST3-MB-BK	Metal Bank	0.24	
	ST3-MB-MC	Metal Bank	0.14	
	ST4-MB-BK	Pennypack Creek	0.28	
	ST5-PC-BK	Pennypack Creek	0.16	
	ST5-PC-MC	Pennypack Creek	0.090	

mg/kg: milligram(s) per kilogram
NA: not analyzed
USEPA: United States Environmental Protection Agency
[a] The USEPA congener analysis of the fish samples is undergoing validation by the Groups subcontractors. The validation has not been completed.

Table 6-4. Effects of Parental Polychlorinated Biphenyl (PCB) Concentrations

Species	Exposure Media	PCB Type	Exposure Duration	No Effect Concentration[a] (mg/kg wet weight)	Lowest Effect Concentration[a] (mg/kg wet weight)	Effect Endpoint	Reference
Eurasian minnow (*Phoxinus phoxinus*)	Food	Clophen A50	40 days	1.6	15	Larval survival	Bengtsson 1980
Sheepshead minnow (*Cyprinodon variegatus*)	Water	Aroclor 1254	4 weeks	1.9	9.3	Larval survival	Hansen et al. 1974
Common barbel (*Barbus barbus*)	Food	Aroclor 1260	30 days	--	12.5[c]	Fecundity after 1 year depuration	Hugla and Thome 1999
Mummichog (*Fundulus heteroclitus*)	Food	Aroclor 1268	6 weeks	14 to 15	--	Fecundity, fertilization success, hatch success, larval survival, juvenile weight,[b] sex ratios; 2 generation study.	Matta et al. 2001
Mummichog (*Fundulus heteroclitus*)	Food	Aroclor 1268	6 weeks	--	1.5	Increase in growth	Matta et al. 2001
Fathead minnow (*Pimephales promelas*)	Water	Aroclor 1248	250 days	2.8 to 30.6[d]	11 to 50[d]	Larval growth; 2 generation study	DeFoe et al. 1978
Fathead minnow (*Pimephales promelas*)	Water	Aroclor 1254	8 months	105	429	Fecundity[e]	Nebeker et al. 1974
Three-spined stickleback (*Gasterosteus aculeatus*)	Food	Clophen A50	3.5 months	289	--	Fecundity	Holm et al. 1993
Fathead minnow (*Pimephales promelas*)	Water	Aroclor 1260	250 days	350 to 567[d]	--	Larval survival and growth; 2 generation study	DeFoe et al. 1978

mg/kg: milligram(s) per kilogram

[a] PCB concentration in parental fish; concentration in females used if different than males.

[b] increased weight (growth) observed with PCB exposure; not an adverse effect.

[c] concentration converted from dry weight.

[d] concentrations presented graphically by DeFoe et al. (1978) and reported numerically by Jarvinen and Ankley (1999).

[e] control fish contained 1.1 mg/kg to 2.7 mg/kg Aroclor 1254.

Table 6-5. *Lumbriculus* Retrieved from the Bioaccumulation Cages

Year	Station	Location	*Lumbriculus* wet weight (g)
2011	1	Metal Bank Site	19
	2	Metal Bank Site	4.5
	3	Metal Bank Site	22
	4	Metal Bank Site	2
	5	Mouth of Pennypack	0
	6	Mouth of Pennypack	0
2012	1	Metal Bank Site	31
	2	Metal Bank Site	23
	3	Metal Bank Site	0
	4	Metal Bank Site	0
	5	Mouth of Pennypack	0
	6	Mouth of Pennypack	0

g: grams

Table 6-6. Metal Bank Sediment Total PCB Results (unvalidated)
(associated with Bioaccumulation Study)

		Concentration (dry wt.) in ppb					
	Analyte	**Station #1**	**Station #2**	**Station #3**	**Station #4**	**Station #5**	**Station #6**
2012 Congeners (Group)	Total Mono	0.62	0.63	0.26	0.52	0.014	0.044
	Total Di	10	7.3	5.1	7.3	0.19	0.59
	Total Tri	45	32	21	32	0.98	3.9
	Total Tetra	55	66	43	64	3.4	14
	Total Penta	47	110	61	49	4.5	14
	Total Hexa	95	100	120	97	8.0	32
	Total Hepta	60	57	70	70	4.1	24
	Total Octo	29	23	140	22	1.1	9.2
	Total Nona	19	11	210	7.4	0.24	1.4
	Total Deca	4.3	1.9	47	1.7	0.13	0.45
	Total	**370**	**420**	**720**	**350**	**23**	**100**
2012 Aroclors (Group)	A1016	ND	ND	ND	ND	ND	ND
	A1221	ND	ND	ND	ND	ND	ND
	A1232	ND	ND	ND	ND	ND	ND
	A1242	ND	ND	ND	ND	ND	ND
	A1248	150	180	100	180	ND	ND
	A1254	140	170	110	180	43	61
	A1260	150	230	150	300	30	52
	A1262	ND	ND	ND	ND	ND	ND
	A1268	ND	ND	ND	ND	ND	ND
	Total	**440**	**580**	**360**	**660**	**73**	**110**
Total PCB (dry wt.) in ppm							
2012 Congeners		0.37	0.42	0.72	0.35	0.023	0.10
2012 Aroclors		0.44	0.58	0.36	0.66	0.073	0.11
2011 Congeners		0.40	0.45	0.21	0.22	0.079	0.087

ND: not detected

PCB: polychlorinated biphenyl

ppb: parts per billion

ppm: parts per million

Table 6-7. Benthic Diversity Summary

Year	Metric	Mean	St. Dev	St. Error	Coeff. Var
2011	**Metal Bank Site (n=4)**				
	Richness	16	3.0	1.0	16%
	Percent Dominant	53%	15%	7.2%	27%
	Diversity	2.0	0.35	0.17	17%
	Hilsenhoff	8.9	0.43	0.22	4.9%
	Reference Site (n=2)				
	Richness	16	1.0	1.0	6.3%
	Percent Dominant	63%	2.0%	1.4%	2.2%
	Diversity	1.9	0.17	0.12	6.4%
	Hilsenhoff	9.3	0.18	0.13	1.4%
2012	**Metal Bank Site (n=4)**				
	Richness	19	2.0	1.0	9.4%
	Percent Dominant	43%	14%	6.9%	32%
	Diversity	2.1	0.23	0.11	11%
	Hilsenhoff	8.4	0.58	0.29	6.9%
	Reference Site (n=2)				
	Richness	25	5.0	4.0	14%
	Percent Dominant	43%	4.1%	2.9%	6.8%
	Diversity	2.2	0.12	0.090	3.9%
	Hilsenhoff	8.6	0.40	0.28	3.3%

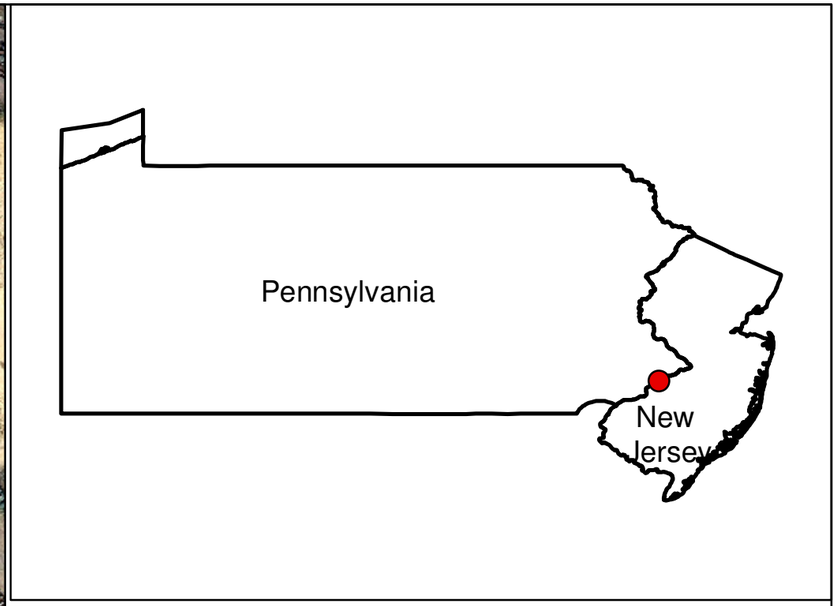
Richness: the total number of taxa

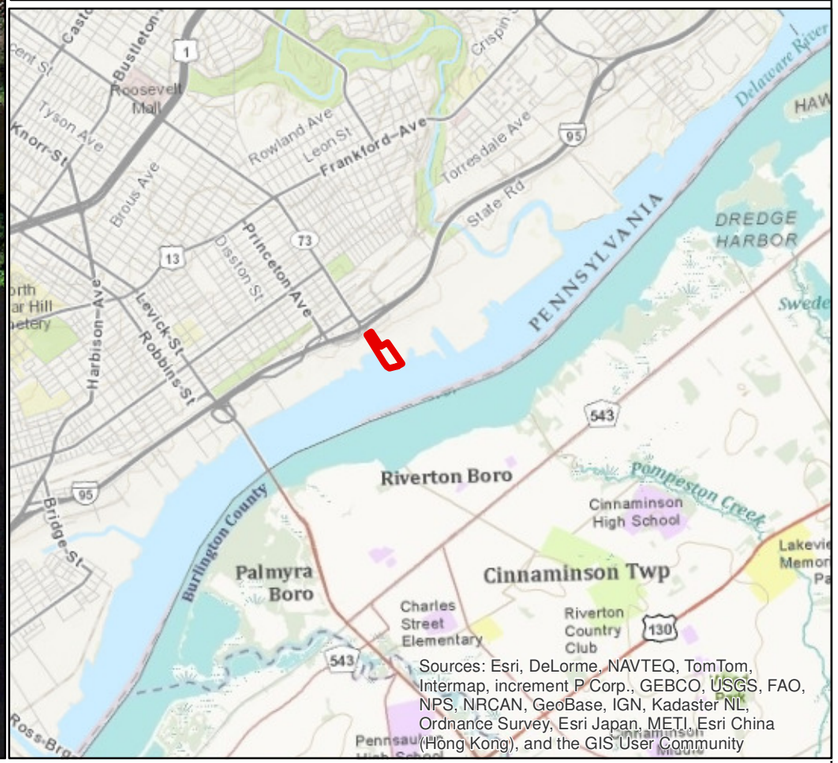
Percent Dominant: the relative abundance of the most common taxon

Diversity: a summary statistic that measures community balanca

Hilsenhoff: a weighted average ranging between 0.00 and 10.00 calculated from the counts and Tolerance Values of the taxa collected

Figures





ENVIRON

Site Location Map
Metal Bank Superfund Site
Philadelphia, PA

Figure 1

GENERAL NOTES

PROJECT COORDINATE SYSTEM:
HORIZONTAL: PENNSYLVANIA STATE PLANE COORDINATE SYSTEM (SPCS), PA SOUTH ZONE, NORTH AMERICAN DATUM (NAD) 83/92.
VERTICAL: NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88)

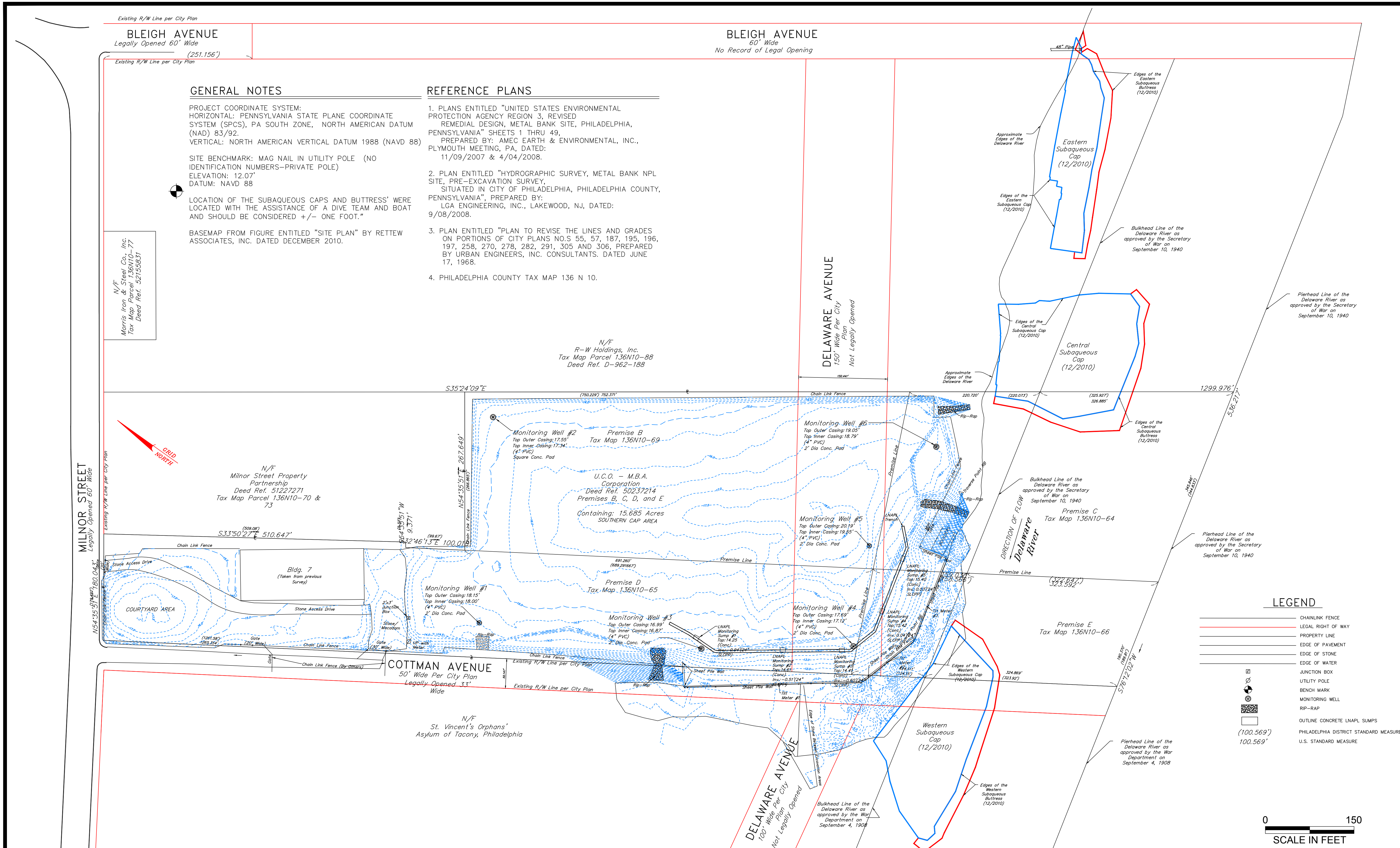
SITE BENCHMARK: MAG NAIL IN UTILITY POLE (NO IDENTIFICATION NUMBERS–PRIVATE POLE)
ELEVATION: 12.07'
DATUM: NAVD 88

LOCATION OF THE SUBAQUEOUS CAPS AND BUTTRESS' WERE LOCATED WITH THE ASSISTANCE OF A DIVE TEAM AND BOAT AND SHOULD BE CONSIDERED +/– ONE FOOT."

BASEMAP FROM FIGURE ENTITLED "SITE PLAN" BY RETTEW ASSOCIATES, INC. DATED DECEMBER 2010.

REFERENCE PLANS

1. PLANS ENTITLED "UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION 3, REVISED REMEDIAL DESIGN, METAL BANK SITE, PHILADELPHIA, PENNSYLVANIA" SHEETS 1 THRU 49, PREPARED BY: AMEC EARTH & ENVIRONMENTAL, INC., PLYMOUTH MEETING, PA, DATED: 11/09/2007 & 4/04/2008.
2. PLAN ENTITLED "HYDROGRAPHIC SURVEY, METAL BANK NPL SITE, PRE-EXCAVATION SURVEY, SITUATED IN CITY OF PHILADELPHIA, PHILADELPHIA COUNTY, PENNSYLVANIA", PREPARED BY: LGA ENGINEERING, INC., LAKEWOOD, NJ, DATED: 9/08/2008.
3. PLAN ENTITLED "PLAN TO REVISE THE LINES AND GRADES ON PORTIONS OF CITY PLANS NO.S 55, 57, 187, 195, 196, 197, 258, 270, 278, 282, 291, 305 AND 306, PREPARED BY URBAN ENGINEERS, INC. CONSULTANTS. DATED JUNE 17, 1968.
4. PHILADELPHIA COUNTY TAX MAP 136 N 10.



ENVIRON

DRAFTED BY: JPH

DATE: JANUARY 2013

SITE LAYOUT
METAL BANK NPL SITE

PHILADELPHIA, PENNSYLVANIA

FIGURE
2

JHNATKO 1/22/13 [SITE LAYOUT FOR ANNUAL REPORT-2]
C:\USERS\JHNATKO\DOCUMENTS\WORK\METALBANK

ENVIRON

Biological Monitoring Locations
Metal Bank NPL Site
Philadelphia, PA

Figure 3